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0CAN081301

10CFR 50.73

August 22, 2013

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

Subject: Licensee Event Report 50-313/2013-001-01
ANO-1 Main Generator Stator Temporary Lift Assembly Failure
Arkansas Nuclear One Unit 1 and Unit 2
Docket Numbers 50-313 and 50-368
License Numbers DPR-51 and NPF-6

Dear Sir or Madam:

Pursuant to the reporting criteria of 10CFR 50.73, Licensee Event Report (LER) 50-313/2013-001-00 was submitted on May 24, 2013, concerning the collapse of a temporary lift assembly for the Arkansas Nuclear One (ANO) Unit 1 Main Generator Stator. The attached LER is a supplemental report and satisfies the reporting requirements for both ANO Unit 1 and ANO Unit 2.

This document contains no new regulatory commitments. Should you have any questions concerning this issue, please contact Stephenie Pyle, Licensing Manager, at 479-858-4704.

Sincerely,

Original signed by Jeremy G. Browning

JGB/slc

Attachment: Licensee Event Report 50-313/2013-001-01

cc: Mr. Steven A. Reynolds
Regional Administrator
U. S. Nuclear Regulatory Commission
Region IV
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NRC FORM 366 (10-2010) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB: NO. 3150-0104 EXPIRES: 10/31/2013

Estimated burden per response to comply with this mandatory collection request: 80 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the FOIA/Privacy Section (T-5 F53), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to infocollects.resource@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202, (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

LICENSEE EVENT REPORT (LER)

(See reverse for required number of digits/characters for each block)

1. FACILITY NAME	2. DOCKET NUMBER	3. PAGE
Arkansas Nuclear One – Unit 1	05000313	1 OF 6

4. TITLE Collapse of a Main Generator Stator Temporary Lift Assembly Results in a Fatality, Multiple Injuries, a Plant Scram, a Notification of Unusual Event, and Dual Unit Structural Damage

5. EVENT DATE			6. LER NUMBER			7. REPORT DATE			8. OTHER FACILITIES INVOLVED	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO.	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
03	31	2013	2013	- 001 -	01	08	22	2013	Arkansas Nuclear One-Unit 2	05000368
									FACILITY NAME	DOCKET NUMBER

9. OPERATING MODE

6

10. POWER LEVEL

0

11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: *(Check all that apply)*

☐ 20.2201(b)	☐ 20.2203(a)(3)(i)	☐ 50.73(a)(2)(i)(C)	☐ 50.73(a)(2)(vii)
☐ 20.2201(d)	☐ 20.2203(a)(3)(ii)	☐ 50.73(a)(2)(ii)(A)	☐ 50.73(a)(2)(viii)(A)
☐ 20.2203(a)(1)	☐ 20.2203(a)(4)	☐ 50.73(a)(2)(ii)(B)	☐ 50.73(a)(2)(viii)(B)
☐ 20.2203(a)(2)(i)	☐ 50.36(c)(1)(i)(A)	☐ 50.73(a)(2)(iii)	☐ 50.73(a)(2)(ix)(A)
☐ 20.2203(a)(2)(ii)	☐ 50.36(c)(1)(ii)(A)	☒ 50.73(a)(2)(iv)(A)	☐ 50.73(a)(2)(x)
☐ 20.2203(a)(2)(iii)	☐ 50.36(c)(2)	☐ 50.73(a)(2)(v)(A)	☐ 73.71(a)(4)
☐ 20.2203(a)(2)(iv)	☐ 50.46(a)(3)(ii)	☒ 50.73(a)(2)(v)(B)	☐ 73.71(a)(5)
☐ 20.2203(a)(2)(v)	☐ 50.73(a)(2)(i)(A)	☐ 50.73(a)(2)(v)(C)	☐ OTHER
☐ 20.2203(a)(2)(vi)	☐ 50.73(a)(2)(i)(B)	☒ 50.73(a)(2)(v)(D)	Specify in Abstract below or in NRC Form 366A

12. LICENSEE CONTACT FOR THIS LER

FACILITY NAME	TELEPHONE NUMBER *(Include Area Code)*
Stephenie L. Pyle, Licensing Manager	479-858-4704

13. COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT

CAUSE	SYSTEM	COMPONENT	MANU-FACTURER		SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX
NA	NA	NA	NA	NA				

14. SUPPLEMENTAL REPORT EXPECTED

☐ YES *(If yes, complete 15. EXPECTED SUBMISSION DATE)* ☒ NO

15. EXPECTED SUBMISSION DATE

MONTH	DAY	YEAR
NA	NA	NA

ABSTRACT *(Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines)*

On March 31, 2013, at approximately 0750 CDT, during lifting and removal of the Arkansas Nuclear One Unit 1 (ANO-1) original Main Generator Stator (Stator), the temporary lift assembly collapsed due to failure of one of the structural columns, resulting in the Stator falling onto the turbine deck (386' elevation) and rolling down into the ANO-1 train bay (354' elevation) adjacent to Arkansas Nuclear One Unit 2 (ANO-2). The event resulted in one fatality, multiple injuries, structural damage to the ANO-1 and ANO-2 turbine buildings, and damage to non-vital systems and electrical equipment. At the time of the event, ANO-1 was in MODE 6 and ANO-2 was in MODE 1 at approximately 100 percent power. The event resulted in a loss of offsite power for ANO-1, with both Emergency Diesel Generators (EDGs) starting to supply safety loads. ANO-1 decay heat removal was lost for approximately four minutes. ANO-2 automatically tripped off-line after the vibration from the dropped Stator resulted in the actuation of relays in the ANO-2 switchgear located adjacent to the train bay, subsequently tripping a reactor coolant pump motor breaker. After the reactor trip, emergency feedwater was manually initiated by ANO-2 Control Room Operators. As debris fell into the train bay, an 8-inch firewater pipe was ruptured and the Alternate AC Diesel Generator electrical tie to ANO-1 was severed. At 0923 CDT that same day, water intrusion from the ruptured firewater piping into a 4160 volt breaker resulted in an ANO-2 Startup Transformer lockout, de-energizing a safety bus. An EDG automatically started as designed and supplied the affected safety bus. An ANO-2 Notification of Unusual Event was declared at 1033 CDT due to fire or explosion from an electrical fault in the 4160 volt switchgear with indications of bus damage. After damage assessment and repairs, ANO-2 returned to power operation on April 28, 2013. ANO-1 returned to power operation on August 7, 2013.

NARRATIVE

A. Plant Status

At the time of the event, Arkansas Nuclear One Unit 1 (ANO-1) was in MODE 6 for the 1R24 Refueling Outage, with decay heat removal in service and offsite power available. Arkansas Nuclear One Unit 2 (ANO-2) was in MODE 1 at approximately 100 percent power. All systems and components that were needed to mitigate, reduce the consequences of, or limit the safety implications of the event were available at the onset of the event. Any times specified in this document refer to Central Daylight Time (CDT).

B. Event Description

Entergy Operations, Inc. contracted with a turbine generator vendor to perform generator modernization on ANO-1 Main Turbine Generator Stator (Stator) [TB][GEN] during the 1R24 Refueling Outage. The vendor subcontracted a heavy lift company for heavy lift services to remove the existing Stator and install a refurbished Stator. On March 31, 2013, at approximately 0750, during lifting and removal of the original ANO-1 Stator (weighing approximately 529 tons), the temporary lift assembly collapsed, resulting in the Stator falling onto the turbine deck floor (386' elevation), then rolling down into the ANO-1 train bay (354' elevation) adjacent to ANO-2 and landing on the Stator transportation vehicle parked in the train bay. Structural members of the Stator temporary lift assembly fell onto the ANO-1 and ANO-2 turbine deck floor, resulting in the fatality of one individual and multiple other injuries. As debris fell into the train bay, an 8 inch firewater pipe [KP] was ruptured and the Alternate AC Diesel Generator (AACDG) [EK][BU] electrical tie to ANO-1 was severed, rendering the AACDG unavailable to either ANO-1 or ANO-2.

ANO-1: When the Stator impacted the ANO-1 turbine deck floor, part of the concrete and steel floor structure collapsed onto electrical buses beneath the turbine deck, resulting in a loss of offsite power to ANO-1. Both ANO-1 Emergency Diesel Generators (EDGs) [EK][DG] automatically started and connected to their respective 4160 volt safety buses. Service water pumps [BI][P] automatically restarted and restored service water header pressure as designed. ANO-1 decay heat removal (DHR) [BP] flow was re-established after being lost for approximately four minutes. Spent fuel pool (SFP) cooling [DA] was restored with a SFP temperature increase of less than three degrees. Offsite power was restored to ANO-1 safety buses on April 6, 2013.

ANO-2: Vibration from the dropped Stator resulted in the actuation of relays in the ANO-2 switchgear located adjacent to the train bay, subsequently tripping the 2P-32B Reactor Coolant Pump (RCP) motor breaker [EA][BKR], resulting in a core protection calculator (CPC) [ID] signal to automatically trip the ANO-2 reactor. The initial plant response to the trip was normal, with the exception that the position indication for the Feedwater Loop "A" Main Feedwater (MFW) Regulating Valve [SJ][FCV] indicated the valve to be partially open, when in fact the valve had closed as designed. In response to this indication, the ANO-2 Control Room Operators secured the main feedwater pump [SJ][P] and manually initiated the emergency feedwater (EFW) system [BA] for approximately twenty minutes. At 0923, water from the ruptured firewater piping migrated into a Startup Transformer 3 (SU3) [EA][XFMR] 4160 volt feeder breaker cubicle [EA][BKR], resulting in an electrical short and SU3 lockout. Bus 2A-2 de-energized as designed, which in turn de-energized 2A-4 [EB][BU], one of two 4160 volt safety buses.

Event Description - continued

The 2K-4B EDG [EK][DG] automatically started and connected to the 2A-4 safety bus. Bus 2A-1 transferred to the second offsite power source, Startup Transformer 2 (SU2) [EA][XFMR], which in turn powered the redundant 4160 volt safety bus, 2A-3.

A Notification of Unusual Event due to fire or explosion was declared on ANO-2 at 1033 based on an observed electrical fault in the 4160 volt switchgear with indications of bus damage. With the loss of SU3, 6900 volt buses 2H-1 and 2H-2 de-energized, resulting in a loss of the remaining RCPs and the one running circulating water pump. This resulted in the need to commence a natural circulation cooldown on ANO-2 using the atmospheric dump valves to remove heat from the steam generators. The 2A-4 safety bus was re-energized from offsite power on April 2, 2013, and ANO-2 achieved MODE 5 (cold shutdown) at 0213 on April 3, 2013. As a result of the ANO-1 Stator drop, systematic walkdowns and evaluations of ANO-2 structural damage were performed to determine the extent of damage, and to determine requirements for the restart of ANO-2.

The AACDG availability was restored to ANO-2 on April 15, 2013, and to ANO-1 on July 23, 2013. After necessary evaluations and repairs were completed, ANO-2 returned to power operation on April 28, 2013. After repairs to the ANO-1 turbine building, Main Generator Stator replacement, and completion of the 1R24 Refueling Outage, ANO-1 returned to power operation on August 7, 2013.

C. Event Causes

The direct cause of the temporary lift assembly failure was buckling of the northwest lower column of the north tower, which was confirmed by examination of failed components that showed visual evidence of tensile overload and bending of this support. This conclusion was supported by finite element analysis of the temporary lift assembly design. The primary root cause of the collapse of the temporary lift assembly was the failure of the vendors to ensure that the design of the temporary lift assembly north tower could support the loads anticipated for the lift. A second root cause was a failure on the part of the heavy lift vendor to perform required load testing of their modified temporary lift assembly prior to its use at ANO.

D. Corrective Actions

Corrective actions planned to address this event include:

- A revision to the Entergy Material Handling Program procedure to require a documented engineering response (if not previously performed) to evaluate critical lifts when using specially designed temporary lifting devices to include an owners review for the lift assembly design, third party independent review of vendor calculations, verification of load testing, finite element analysis of the design if load tested to less than 125 percent of the anticipated load, additional safety factors where load testing is not possible, and establishment of exclusion zones considering the potential failure of the lift assembly.
- A revision to the Entergy Project Management procedure to provide contract language guidance that ensures detailed engineering calculations, quality requirements and standards are provided for internal and third party review in accordance with the revised Material Handling Program when specially designed temporary lift assembles are to be used.

E. Safety Significance Evaluation

Industrial Safety

When the temporary lift assembly failed, components fell onto the turbine deck in the immediate vicinity of a number of plant workers. The falling components struck several workers resulting in the loss of one individual's life and injuries to other workers. Workers were also injured as they attempted to avoid being struck by the falling components. This event was significant with respect to industrial safety.

Nuclear, Radiological, and Public Safety: ANO-1

The damage to the Unit 1 non-vital 4160 volt switchgear and subsequent loss of offsite power to ANO-1 resulted in a loss of DHR and SFP cooling. The plant operated as designed, given the refueling outage configuration at the time of the event. Both EDG's automatically started and connected to the respective 4160 volt vital switchgear, permitting Operations to promptly restore DHR and providing redundant EDG and vital 4160 V switchgear for DHR defense-in-depth capability.

Operator response, including prompt procedure reference and use related to the loss of DHR, loss of instrument air, fire water leak, and loss of normal control room communications, effectively mitigated any significant challenge to nuclear safety. As a result of expected Operator and equipment response, SFP cooling was restored with minimal increase in SFP temperature. SFP and RCS makeup sources, if needed, were available within seconds of the event following connection of an EDG to the respective 4160 volt vital switchgear. RCS inventory was maximized prior to the Stator lift, providing a substantial margin to safety with regard to nuclear and public safety. Prompt action was taken to secure the firewater system pumps to limit ponding in undesired areas, while the capability to place a firewater pump in service remained available throughout the event.

Steam Generator nozzle dams were closely monitored and compensatory actions initiated in the event that power or air supply remained unavailable over the long term. The nozzle dams are designed to limit leakage to a minimum in the event of a complete depressurization. Such leakage would have been easily accommodated by the available makeup sources.

While the ANO-1 Safety Analysis Report considers a loss of DHR or SFP cooling event, the only refueling mode accident assumed is the fuel handling accident. The loss of non-vital power would not have caused an ANO-1 fuel handling accident or prevented a fuel assembly from being placed in a safe condition, therefore, would not have resulted in dose consequences to the public exceeding federal limits. In summary, the Stator drop event did not significantly increase the probability of a fuel handling accident or the consequences thereof.

Safety Significance Evaluation - continued

Nuclear, Radiological, and Public Safety: ANO-2

The stator drop resulted in inadvertent loss of a RCP, later followed by a lockout of the SU3 transformer (normal offsite power source). Because ANO-2 is not designed to operate with less than all four RCPs, an automatic reactor trip occurred as designed. Following the trip, one of the MFW regulating valves indicated partially open, requiring proceduralized Operator action to secure all MFW and actuate the EFW system. All safety systems responded as designed.

As required by procedure, only one electrical train is aligned for transfer to SU2 should a loss of SU3 occur. Per design, the loss of SU3 resulted in one electrical train transferring to SU2, with the vital portion of the remaining electrical train powered from the respective EDG. With SU3 unavailable, the non-vital 6900 volt buses which power the RCPs and circulating water pumps were lost, resulting in natural circulation cooling utilizing the atmospheric dump valves. Appropriate procedures were entered and utilized to support proper event response. The licensed Operators are well trained with respect to event response, including core cooling by means of natural circulation. The ANO-2 accident analyses do not require the availability of RCPs or the condenser for core cooling or maintaining the fuel in a safe condition.

The loss of SU3 initially resulted in the loss of the in-service SFP cooling pump; however, Operations promptly restored SFP cooling by procedurally establishing a power source via bus cross-ties and placing the standby SFP cooling pump in service.

Because both onsite and offsite power remained available and procedures were available and utilized in response to the events resulting from the Stator drop, no significant challenge to nuclear safety was evidenced. Because the ANO-2 nuclear safety impact was minimal and because no loss of control or a release of radiological material occurred, no significant challenge to radiological safety resulted from the Stator drop event; therefore, the health and safety of the public was not adversely affected.

Conclusion: Based on the discussions above for ANO-1 and ANO-2, there were no significant challenges to nuclear safety and no significant challenges to radiological safety resulting from the Stator drop event; therefore, the health and safety of the public was not adversely affected.

F. Basis For Reportability

This event is reported pursuant to the following criteria:

10CFR 50.73(a)(2)(iv):

(A) Any event or condition that resulted in manual or automatic actuation of any of the systems listed in paragraph (a)(2)(iv)(B) of this section.

(B) The systems to which the requirements of paragraph (a)(2)(iv)(A) of this section apply are:
(1) Reactor protection system including: reactor scram or reactor trip
(ANO-2 reactor trip)
(6) PWR auxiliary or emergency feedwater system
(ANO-2 emergency feedwater manual actuation)
(8) Emergency ac electrical power systems, including: emergency diesel generators
(ANO-1: Both EDGs actuated on loss of offsite power)
(ANO-2: "B" EDG actuated)

10CFR 50.73(a)(2)(v)

Any event or condition that could have prevented the fulfillment of the safety function of structures or systems that are needed to:
(B) Remove residual heat;
(ANO-1 Decay Heat Removal)
(D) Mitigate the consequences of an accident.
(ANO-1 Loss of offsite power)

G. Additional Information

10CFR 50.73(b)(5) states that this report shall contain reference to “any previous similar events at the same plant that are known to the licensee.” NUREG-1022 reporting guidance states that term "previous occurrences" should include previous events or conditions that involved the same underlying concern or reason as this event, such as the same root cause, failure, or sequence of events.

A review of the ANO corrective action program and Licensee Event Reports revealed no relevant similar events.

Energy Industry Identification System (EIIS) codes and component codes are identified in the text of this report as [XX].